

MR. ROBERT MALLET¹ was born on the 3rd of June, 1810, in Dublin, where his father, John Mallet, originally of Devonshire, had established a brass and copper foundry. Young Mallet was at first a weakly child, but outgrew his ailments and became of very strong constitution. Until the age of sixteen he was educated at Bective House, a well-known school in Dublin, then kept by the Rev. G. N. Wright. On leaving the care of Mr. Wright he made his first visit to the Continent, in the company of the Rev. C. Barden, clergyman of the parish in which he lived, and of his future brother-in-law, Mr. William Watson, Assoc. Inst. C.E. In December 1826, he entered at Trinity College, Dublin, remaining there until he took his A.B. degree, four years later. During all this time he paid particular attention to engineering matters, but he was especially fond of chemistry, in which he attained marked proficiency. When only a little over twelve years of age he occupied so much of his time in boyish experiments and in making unsavoury chemical mixtures, that a small room was set apart as his laboratory, and whenever his mischievous pranks had to be corrected, the severest punishment was found to be his banishment from this elysium for a term proportioned to the magnitude of his offence.

After leaving college he spent a good deal of time in his father's works, and visiting engineering establishments in England at every opportunity, taking, at the same time, practical out-door lessons in surveying and levelling from Mr. J. J. Byrne. The rapidity with which he acquired practical engineering was remarkable.

In the year 1831 Mallet made an extended tour on the Continent in company with Mr. Purser, of Rathmines Castle, and Mr. Friedlezius, a Swedish Professor of Mathematics, under whose tuition the young engineer had been. On his return he became a partner in his father's works, and soon assumed the responsible charge of the Victoria Foundry, and the attached fitting and machine shops, and expanded the whole into a large concern, which in a few years absorbed all the engineering work of note carried out in Ireland.

One of his first works of importance, interesting for its originality, was the raising and sustaining of the roof of St. George's Church, Dublin. This roof, a massive construction, weighing 133

¹ The substance of this memoir is derived from information furnished by Dr. J. W. Mallet of the University of Virginia, largely supplemented by notices in the *Engineer*, of November 11 and 18, 1881.

tons, had failed, owing, as was supposed, to the use of the short timbers necessitated when it was built, the usual sources of supply being closed by reason of the great war. The walls of the church were bulged, and were in such a dangerous state, that it was proposed to unroof the building and put it up afresh. Mallet, however, offered, with due guarantee in case of failure, to raise and sustain the roof without damage to the ceiling. This he successfully accomplished by employing screw-jacks, which, being worked simultaneously, lifted the whole roof clean off the wall plates. A strong iron truss framing was then attached, and the whole suspended from it. A description of this work was presented to the Institution,¹ for which the Author received a Walker premium. In 1841 Mallet constructed a manumotive engine to carry the mails between Kingstown and Dublin. It was worked by eight men, and made the trip (about 5 miles) each way in twenty minutes. He also constructed a fine 40-ton crane for the Kingstown Wharf.

At this time the celebrated firm of brewers, Messrs. Guinness and Co., began to consult him upon various matters, and amongst other things he did was to give them a supply of water by boring a 4-in. hole through the solid rock at the bottom of a well that had given out, and then firing a charge of powder therein, by which the rock was shattered, and a supply of water obtained which has never since failed. He also constructed a machine worked by steam for washing casks, and erected a very large sky cooler for the brewery, which was then rapidly increasing in fame. Steam engines of various sizes were made in the works from his designs. The barrel-washing machines were also made for Messrs. D'Arcy and Messrs. Manders and Co. Steam printing and other machinery was made for Messrs. Grierson, then King's printers, and for the 'Dublin Freeman's Journal' and the 'Irish Times.'

In 1836 important works were being carried out by the Shannon Commissioners, Sir John Burgoyne being then the Government engineer, and owing to the skill of its junior member, which was becoming known throughout the country, Mallet's firm secured the contracts for the construction of a large number of bridges, including the swivel bridges over the Shannon at Limerick, Banagher, Portumna, Athlone, and Shannon Harbour. All the sluices and other apparatus were also made by the firm from designs for Robert Mallet.

Besides the varied work which was being carried out from these designs in the Victoria Foundry in 1837, he turned his attention

¹ *Vide Minutes of Proceedings Inst. C.E., vol. I, p. 94.*

to the hydraulic ram, and produced a form of that motor which was employed on the Dublin and Kingstown Railway for forcing water to tanks for the engines.

In May 1839, he was elected Associate of the Institution of Civil Engineers, proposed by Sir W. Cubitt, and seconded by Thos. Rhodes and Francis Bramah, and he was transferred to the class of Member three years afterwards at the recommendation of Sir J. Burgoyne, Mr. Fairbairn, and Mr. Vignoles. During this year the business at the Victoria Works was increasing, but in spite of this and severe family troubles, he managed to find time for experimental and literary work. The handsome tower gate entrance to the Duke of Abercorn's castle grounds was designed and erected by him for the father of the present duke. The gate when first erected was opened and closed by the lodge keeper from within the lodge. A working model of this gate is still to be seen in the duke's castle. At this time also his scientific knowledge was called into play in devising extensive ventilating and heating apparatus for a large number of public buildings, upon which he had to report. Amongst the buildings ventilated and heated from his designs were Dublin Castle and chapel, the Records Office, Law Courts, and numerous prisons and poor houses. In these the heating was effected by hot water, and the apparatus is in working order to this day. In 1840 he turned his attention to the supply of water to Dublin. He surveyed the river Dodder in 1841 at his own expense, and had plans made with a view to furnishing Dublin with pure water, and to supply the paper and other mills in summer time. All the paper mills were stopped in summer, but he proposed to remedy this by constructing six large reservoirs at different levels along the Dodder, so to store up and supply the water which caused floods and ran to waste in the Liffey.

In 1840 Mallet began to make beam engines of considerable power, such as those erected at the Ringsend Dock Mills of Messrs. Hastings and Carter, but the Irish market for steam engines was not more extensive then than now, and he turned his attention more to railway and civil engineering work; he also spent some time in his old college, for which he designed, erected, and fitted out the new laboratory for Dr. Apjohn. His taste in designing ironwork of an architectural character was also well shown in the circular stairs erected on each side of the chancel in Trinity College Chapel, and in the much admired palisading and railing bounding the College from Provost House in Grafton Street, through the whole length of Nassau Street, to Clare Street. The numerous illustrations of failure in the attempt to produce an

iron palisading of pleasing design shows that, though always looked upon as a small matter, it is not a task which can be satisfactorily discharged without some architectural taste.

It is worth remark that the three large 36-horse-power fire engines still used by the Dublin Corporation were made from his designs at the Victoria Foundry in 1841. In 1842-43, the shops were very full of the work to which the drainage operations then in progress and the railway system then fairly largely conducted, and at the same time such work as the construction of the Limerick dock gates, with 80 ft. opening and 24 ft. depth, formed part of the operations carried out under him. Railway signals and ovens for the production of coke for locomotives also employed his workmen. The atmospheric railway also employed much of his attention. He advocated the employment of large vacuum chambers to be exhausted by small engines running constantly, instead of the very large engines which were necessary under the system in use. The vacuum chambers thus proposed would have served the same purpose as the accumulator used for hydraulic machinery, and would have been very economical. The atmospheric system failed, however, owing to its want of flexibility and its costliness.

In 1845-6 he designed and erected the terminal station of the Dublin and Drogheda Railway; the large polygon engine-shed, with a hydraulic turntable in the centre; the Kingsbridge passenger sheds, and all the workshops and other buildings for the Great Southern and Western Railway; the engines and machinery for the Castlecomer Coal Mines, Co. Kilkenny; a 40-ft. overshot water-wheel and machinery for Mr. McDonald's paper-mills in Sagart, Co. Dublin, besides numerous other railway stations. Of this work, the Nore Viaduct should be mentioned, as the design for this, a wooden structure, though nominally prepared by Captain Moorsom, was re-designed by Mallet, as failure might have resulted from following the original drawings. The bridge was 200 feet in span, the main girders or wood trusses being 22 feet in depth, constructed of Canadian hemlock, a wood very similar to pitch pine, but not possessing the strength of that material. Six hundred tons of timber were used in its construction, and during the erection a flood rise of 5 feet 9 inches took place in one night, bringing down cots and hay which rested against the staging, and the whole structure only just missed being wrecked in consequence. The timber trusses were replaced in 1876 by an iron lattice girder, constructed by Messrs. Courtenay, Stephens, and Bailey, from designs by Mr. R. Galwey, C.E. Moorsom's whole design

was considered by Mallet to be a mistake, as the situation was eminently well suited for a three-arch masonry bridge.

In 1849 he designed and constructed the iron station roofs at Belfast, Portadown, and Armagh. He also constructed the large engine-shed of the Lancashire and Yorkshire Railway at Miles Platting, of which Mr., now Sir, John Hawkshaw, was Engineer-in-chief. This was known as the Irish shed, and in the following year he eclipsed this performance by the construction of the Wakefield passenger shed for the same Company. The main roof is 95 feet in span and 750 feet long, and the whole structure was erected without any interruption to the traffic. That these structures should be made in Ireland excited great surprise at the time, but there were not so many firms then as now who could undertake that class of work.

The Fastnet Rock Lighthouse from the designs of Mr. George Halpin, then Engineer to the Port of Dublin, was built by Mallet in 1848-9. The tower is 63 feet 9 inches from base to gallery, and the lantern, of brass, is 30 feet high.

About the year 1840 he had commenced some experiments with the buckled plates, by which his name is well known to many ignorant of his connection with science and the arts. The buckled plate, patented in 1852, was one of the most successful of his inventions in a commercial sense, although in most other men's hands it would have been worth a hundredfold what it ever was to him. It was one of Mallet's faults that he had little commercial tact. As it was, however, the buckled plates were very extensively used in this country and abroad. They formed, perhaps, the best floor ever made, combining the maximum of strength with the minimum of depth and weight. They were employed on the Westminster and other London bridges, one of which was floored at Mallet's cost, owing to his own laxity in accepting verbal assurances from a contractor from whom the most stringent conditions should have been secured. He received a prolongation of the patent in 1866. He subsequently took out patents for buckled plate railway sleepers, and on the Bolivar Railway sixty miles of these cross-sleepers were laid by Messrs. Brunlees and McKerrow.

In 1850 he turned his attention to the construction of large guns, and first practically investigated the physical conditions involved in the construction of ringed ordnance, and in 1854 designed his monster mortars for throwing 36-inch shells.¹ Two

¹ Transactions of the Royal Irish Academy, 1856; and separately in book form, 4to., London, 1856. Longman and Co.

of these mortars were constructed for use at the Siege of Sebastopol, but were not used owing to peace having been proclaimed before the large iron rafts, specially designed for their reception, were ready.

The 70-ton sheerlegs at the Victoria (London) Docks were built by Messrs. C. J. Mare & Co., of Blackwall, from Mallet's designs. With the completion of the trunk lines in Ireland the work required to keep going such a concern as the Victoria Foundry gradually became scarce. Ironworks had so increased in number and variety in England and Scotland, that after importing iron and coal into Dublin prices became too high to permit profitable competition with English and Scotch firms. The failure to obtain the contract for pipes for an extension of the Dublin Waterworks determined the closing of the works after Mallet and his father had, as they thought satisfactorily, shown that such an establishment could not be maintained in Ireland.

In 1861 Robert Mallet gave up his house at Glasnevin, in Dublin, and came to London, when he opened an office in Westminster and practised as a consulting engineer, also attending to his patents. He edited the "Practical Mechanics' Journal," besides contributing largely to "The Engineer," and gave evidence as a scientific witness in patent cases. In 1863 he was employed by the proprietors of the Hibernia and other collieries in Westphalia to report on the best means of sinking and ventilation of their pits, with which they had encountered considerable difficulty. A year later he became associated with Mr. J. S. Burke in the scheme known as the Dublin Trunk Connecting Railway. The Act was obtained and the works of the railway fairly started, but, owing to some commercial and legal difficulties, they were stopped in 1866, after a large sum of money had been expended on the excavation and masonry of the shaft on the southern side of the Liffey for the tunnel under that river. When the East London Railway was about to seek powers to use the Thames Tunnel, Mallet was called in to report on its strength and condition, and on the possible effect the establishment of the railway so near the Royal Observatory, at Greenwich, might have upon the taking of Astronomical observations. The thorough tests and examination, besides palometric observation, made by him established the perfect security of the tunnel for railway traffic, as well as its non-liability to be injurious to the Observatory. This was probably the latest engineering work in which Mallet was engaged, the remainder of his career being confined to literary labour and to his consulting practice.

This account of Robert Mallet's business engagements is, however, but a portion, and not the most important portion, of his working career. An ordinary man might well be satisfied to show such a record of successful practical work, but the contemplation of Mallet's literary labour, largely achieved in his spare time, suggests the reflection that as a writer alone he claims the abundant recognition of the profession. It is perhaps rather in this capacity, and as a man of science, than as a skilful and original engineer, that his reputation is founded. The Royal Society's "Catalogue of Scientific Papers," which does not give those of a technical character, contains the titles of no less than seventy-four written by him down to 1873. His more important works include three Reports to the British Association (1838-1840-1843) on the action of sea and river water under various conditions upon cast- and wrought-iron; a Report to the same body (1849) on an experimental inquiry on railway bar corrosion; papers on the physical properties of definite alloys of copper with tin and zinc;¹ three Reports on the construction and working of atmospheric railways;² papers on principles and practice of the application of water power;³ memoir on the physical conditions involved in the construction of artillery of large calibre (1855)⁴—this representing a research in connection with the construction by Government of two 36-inch mortars from his designs, and under his superintendence; paper on the corrosion and fouling of iron ships;⁵ numerous and important papers on earthquakes, the rate of propagation of earthquake waves, volcanoes, and the source and mechanism of volcanic energy;⁶ the article on "Seismology" in the "Admiralty Manual of Scientific Engineering;" a special Report to the Royal Society on the expedition into the Kingdom of Naples to investigate the circumstances of the great earthquake of 16th December, 1857;⁷ an elaborate contribution to the literature of volcanic geology, entitled "Volcanic Energy; an attempt to develop its true origin and cosmical relations;"⁸ numerous editorial and other articles in

¹ Proceedings Royal Irish Academy, 1840-44.

² Weale, Quarterly Papers, 1845.

³ *Ibid.*, 1849.

⁴ Transactions of the Royal Irish Academy, 1856; and separately in book form, 4to., London, 1856. Longman and Co.

⁵ Read at session of Institution of Naval Architects, 1872.

⁶ Philosophical Transactions, 1861, 1862, 1873. British Association Reports, 1850-54, 1858. Proceedings of the Royal Irish Academy. Philosophical Magazine. Quarterly Journal of the Geological Society, &c.

⁷ Published in two vols., 8vo., in 1862. London: Chapman and Hall.

⁸ Phil. Trans., 1873.

“The Engineer” and “Practical Mechanics’ Journal;” reports on the Heaton method of making steel; on the International Exhibitions of London, 1851 and 1862 (being a juror in the case), and Paris, 1867, &c.

In January 1842 he was awarded a Walker Premium of the Institution of Civil Engineers, and in 1859 a Telford Medal and Premium; in 1862 the Cunningham Medal of the Royal Irish Academy, and in 1877 the Wollaston Gold Medal of the Geological Society.

After a life of unusually sound health and active occupation, in the winter of 1871-2 his eyes suffered from a severe attack, which gradually impaired and, after some time, practically destroyed his sight for all other purposes than merely guiding his movements, although he continued to accomplish much mental work with the aid of an amanuensis. In November 1880 he was attacked by diffuse cystitis, and after a year of much pain, patiently and courageously borne, with continuous confinement to bed, he died peacefully on the 5th of November, 1881.

In addition to Mr. Mallet’s connection with this Institution he was a Fellow of the Royal Society, and was also a member of the following scientific institutions and professional bodies at home and abroad: the Royal Irish Academy (1832), the British Association (1835), Institution of Civil Engineers of Ireland (1836 and President 1866), the Chamber of Commerce of Dublin (1837), Royal Geological Society of Ireland (1847, President), the Royal Scottish Society of Arts (1840), Academy of Science, Arts, and Belles Lettres of Dijon (1853), the Royal United Service Institution (1857), the Geological Society of London (1859), the Royal Philosophical Society of Göttingen (1859), and of several minor societies.

Mr. WILLIAM MILNOR ROBERTS¹ was one of the oldest and most active members of the engineering profession in the United States. He was of Quaker descent, and was born in the City of Philadelphia on the 12th of February, 1810. His education was received in the best private schools of that city, and he devoted two terms to a special course in mathematics under Professor Joseph Roberts. He also pursued a course of architectural

¹ This memoir has been compiled from a notice in the *Rio News*, supplemented by details contained in obituaries in the American engineering journals, circa July 1881.